



Alignment Status

Progress since Feb 99 Lehman Review

- ¥ **Symmetrical layout for alignment laser lines**
 - ¥ Each CSC has mounts in the same location
 - ¥ Complete layout drawings & partial prod. drawings
- ¥ **DCOPS sensor development**
 - ¥ Readout system
 - ¥ Radiation tests of CCDs
 - ¥ Calibration procedure
- ¥ **Prototype elements of system**
 - ¥ Mounts & towers on CSCs
 - ¥ Laser line (SLM) at Fermilab
- ¥ **New wbs structure**



Alignment System Concepts

Connect Endcap CSCs to Tracker

- ¥ Tracker co-ords (points, Φ angles) brought to MAB modules via link system (Spain)
- ¥ 6 axial laser lines (transfer lines) pass through the MABs and run outside each CSC station
 - ¥ Cannot be 60 degrees apart due to MB interference
- ¥ 3 laser lines per CSC station (SLMs) are linked to the axial transfer lines
 - ¥ SLM measures location of CSCs (on 1/6)
 - ¥ SLMs are 60 degrees apart, mount on CSCs at same point on each chamber
- ¥ Connection between axial lines and SLMs on transfer plates



Alignment design

CSC alignment

- ¥ Precise relationship of strips, alignment pins, and sensors on CSCs
- ¥ Precise location of sensors on CSCs using internal calibrations and photogrammetry
- ¥ Radial measurements from transfer plate to CSCs by potentiometers

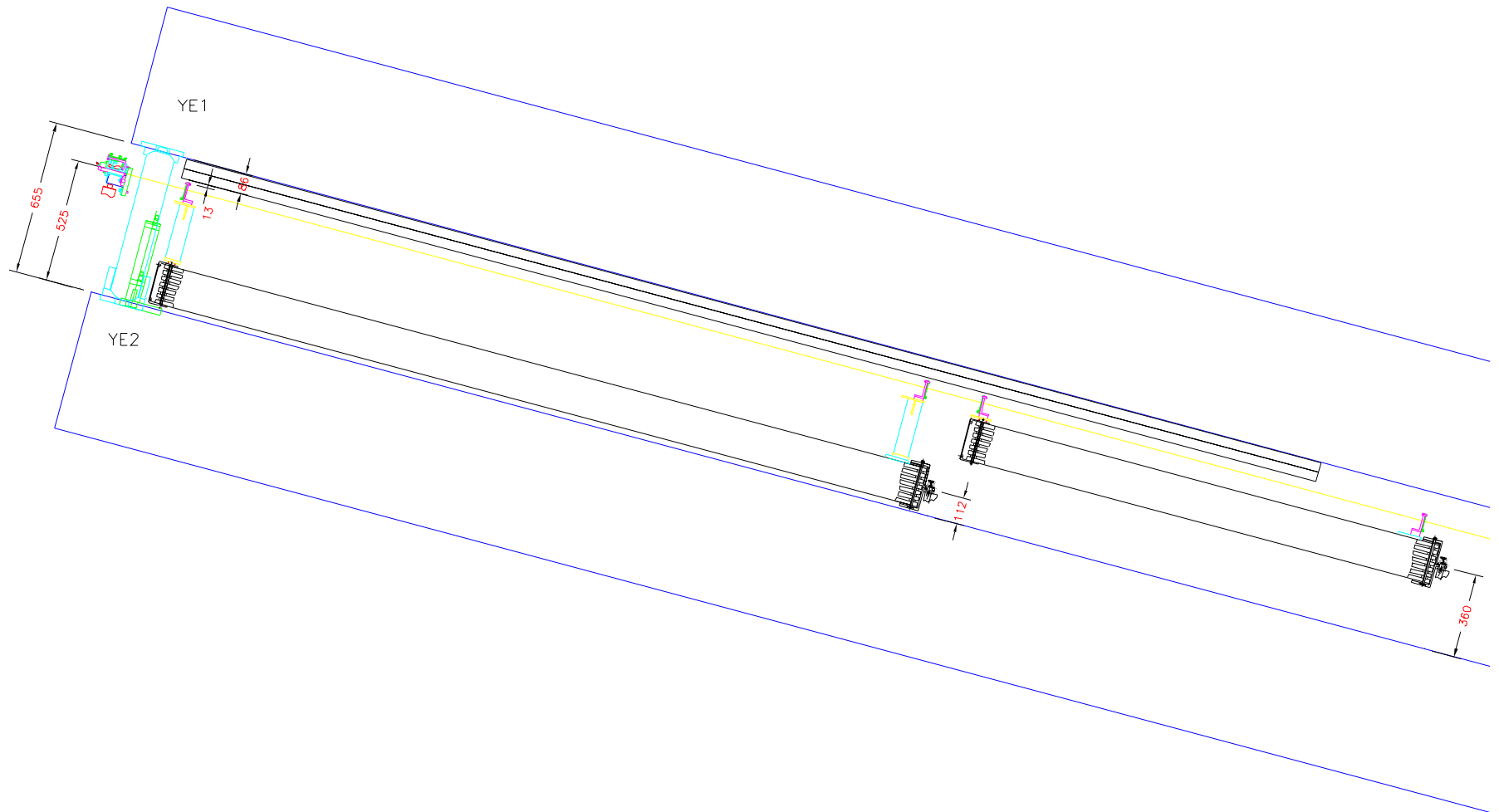
Transfer plate location

- ¥ Axial lines monitor location wrt tracker co-ords
- ¥ Z distance measured by mechanical tubes and optical gap sensors

Cross check using photogrammetry

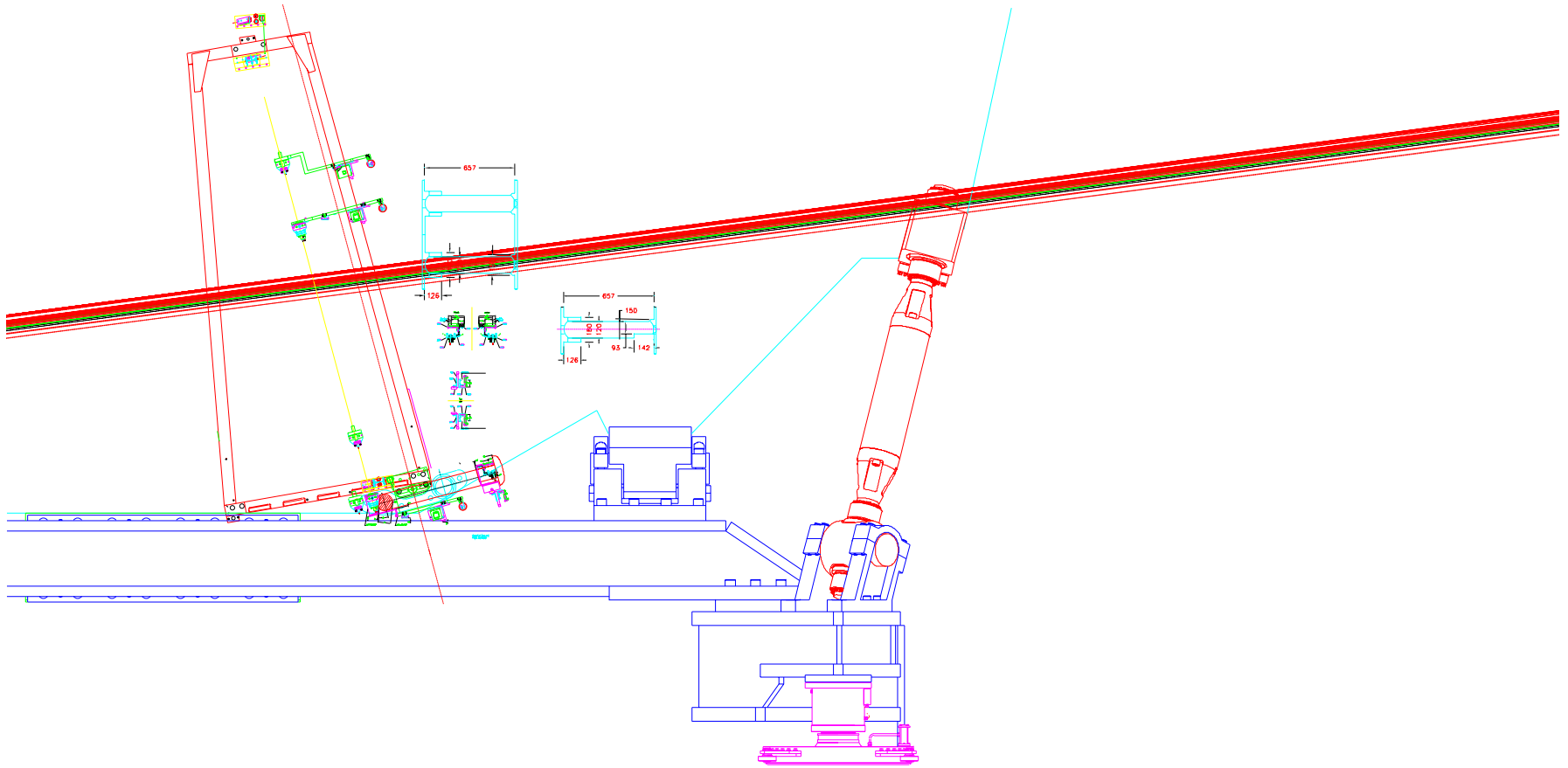


SLM profile view



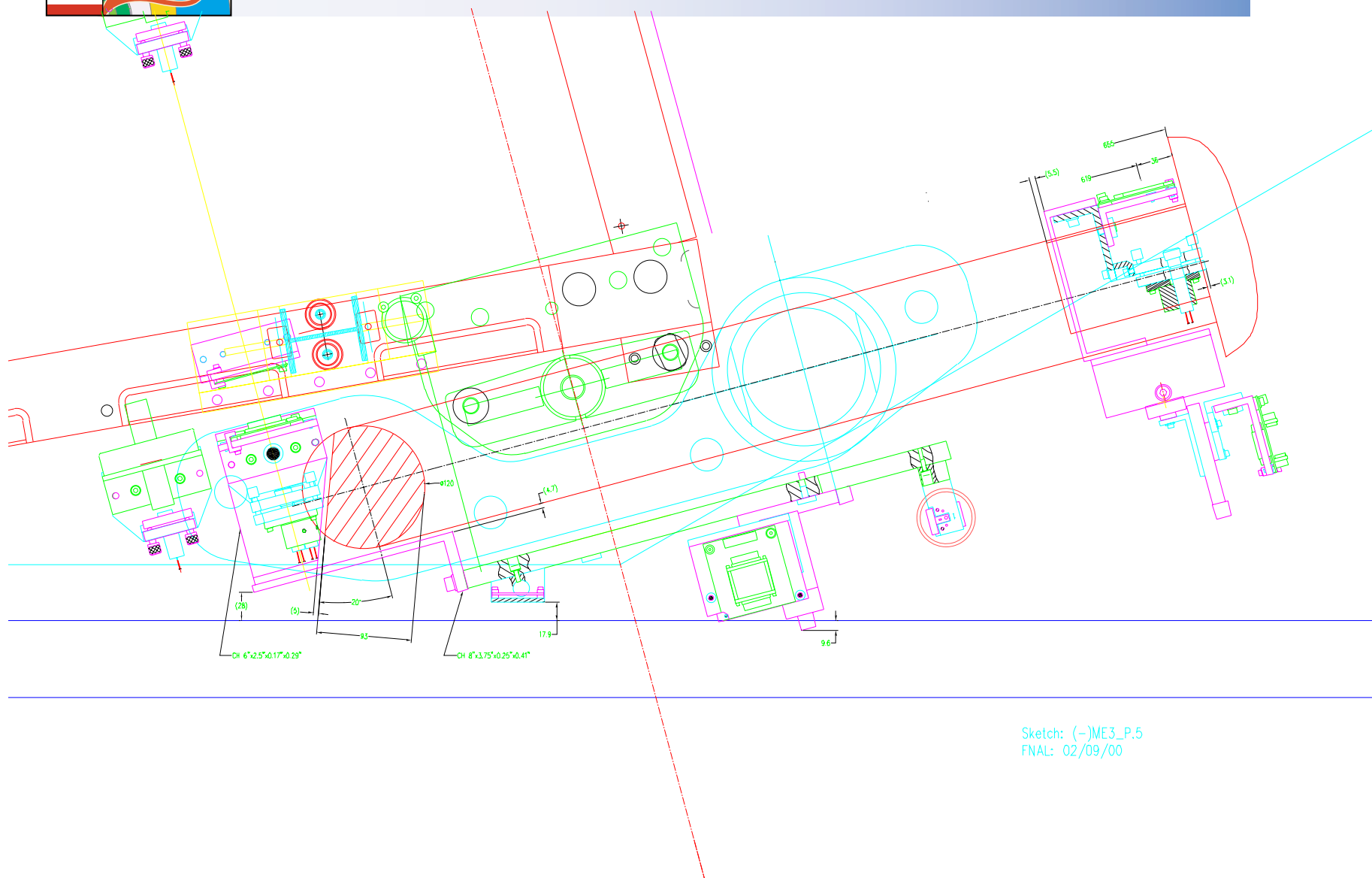


Conflict with YE3 cart





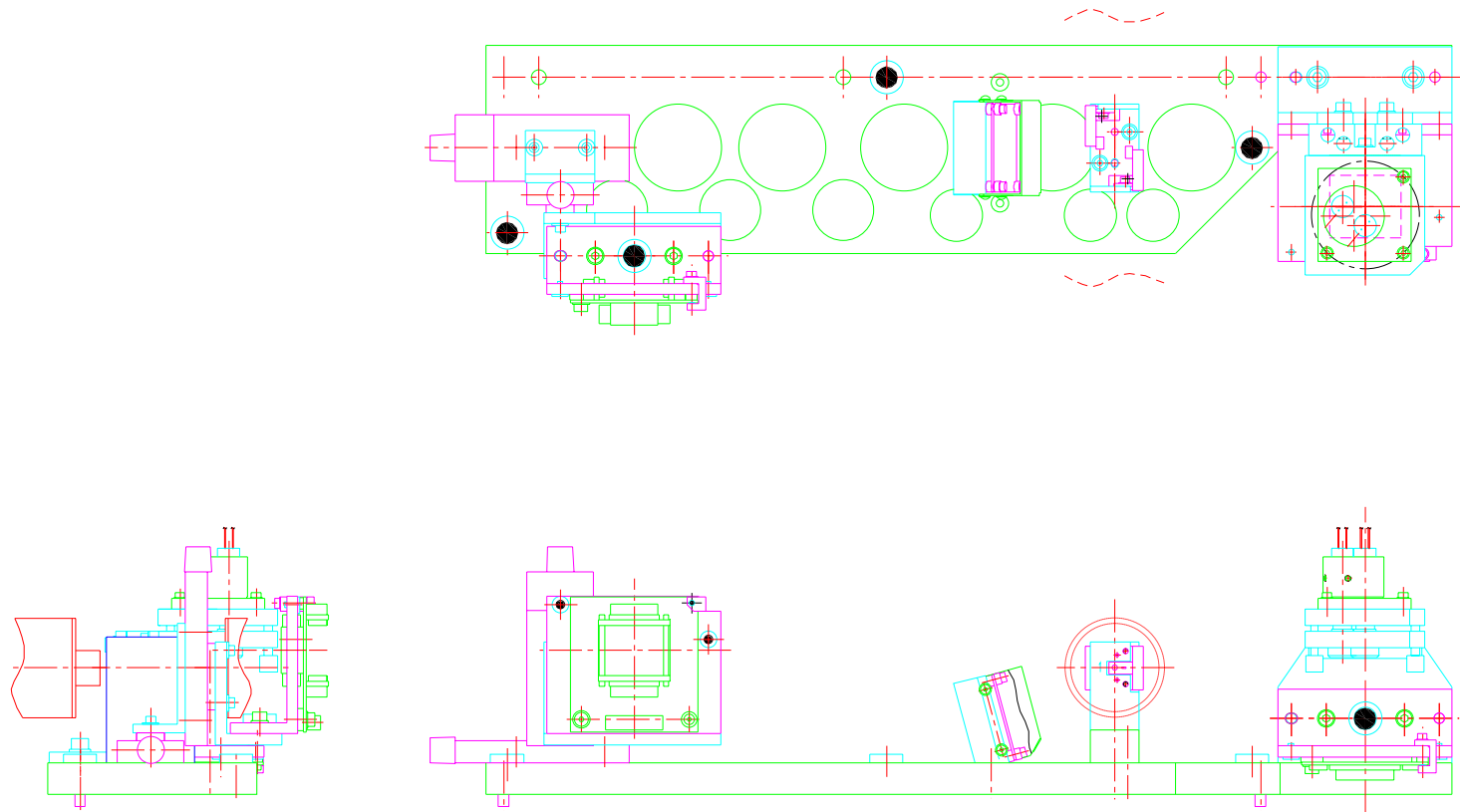
YE3 cart closeup



Sketch: (-)ME3_P.5
FNAL: 02/09/00



Transfer plate



LP-01



Mechanical progress

Layout

¥ Most conflicts resolved

¥ Required some changes to the disk and cart designs

¥ Mount positions on CSCs defined

¥ Prototype mount plates and towers constructed for ME23/2 chamber

¥ Roughly 50% of transfer plate production drawings finished

¥ RPC chambers mounted on opposite wall

¥ SLM lines change z position

¥ Spacer rings change - Kawasaki has new drawings



Sensor technology

Design requirement for our system

- ¥ Many (up to 10) sensors in a line must all be capable of locating the laser beam
- ¥ Present transparent sensors are not transparent enough and projected developments do not match our schedule

Design standard tech sensor

- ¥ Develop design using conventional items (relatively low risk)
- ¥ 4 linear CCDs mounted in a window frame
- ¥ Cross-hair laser beam
- ¥ Readout with DSP processor and serial I/O
- ¥ Digital CCD optical position sensor (DCOPS)



CCD radiation tests

Radiation testing

- ¥ **Can CCDs survive the expected radiation at CMS?**
- ¥ **Test CCDs in 4MeV proton beam at Lowell, MA Van de Graff**
 - ¥ Neutron fluences of 1.3×10^{13} n/cm² per hour
- ¥ **Major effect is an increase in the dark current**
 - ¥ Since dark current is proportional to readout time, a faster readout scheme would improve performance
- ¥ **Present versions of the CCD and readout are acceptable (safety factor roughly 3)**



Sensor choice

Choice of sensors by 1 July 00

¥ **ALMY (transparent sensors)**

¥ Original choice of Atlas & CMS

¥ Transmission may be too low for us

¥ EGG dropped development -- some development at Minnesota

¥ **DCOPS sensor (open sensor)**

¥ Uses a cross-hair laser readout by CCDs

¥ Good test results on resolution & stability

¥ Radiation resistance looks ok

¥ Testing DCOPS sensors in SLM & ISR prototypes

¥ **Likely to select DCOPS as baseline technology**



Alignment tests

SLM -- Fermilab

¥ April 00

¥ Prototype all elements of an SLM line

¥ Develop DAQ system to read complete SLM

ISR -- CERN

¥ June-July 00

¥ Required for the Alignment EDR Review at CERN

¥ Complete alignment test with Link System, Barrel, and Endcap alignment

¥ Endcap will test an SLM line with connection to the MAB (Link System)



Alignment plans

Schedule

- ¥ **ISR test at CERN -- June-July 00**
- ¥ **Sensor technology choice -- July 00**
- ¥ **Engineering design review -- Oct 00**

Tasks

- ¥ **Develop DCOPS production version**
 - ¥ Electronics update (faster readout, low voltages, new serial protocol, DSP programming)
- ¥ **Simulation of alignment system**
- ¥ **Develop analysis programs and interface to trigger and reconstruction**
- ¥ **Evolve DAQ system into CMS slow control**



New Alignment wbs

